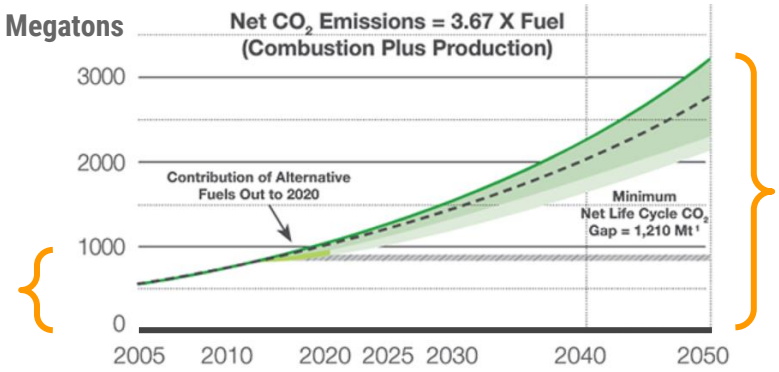
The First Practical Zero Emission Aviation Powertrain

Q4 2020

$1.5T Aviation Market is Flying into Sustainability Crisis



5-10%
Of total human Climate Impact

Today

Useful life of a commercial aircraft

25%

50%

In 2050

No real, truly scalable solutions today

Hydrogen is a Key Enabler of Future Aviation

Options	Primary issues (Blockers)	Secondary issues
Battery electric	40x lower energy density compared to jet fuel; 5x+ higher kwh/kg required to start being relevant in aviation	High OPEX due to cycling costs (including recycling) - need at least 5x cycle life improvement
Turbine - electric	None	Marginal / zero benefit on any but the shortest routes (where turbine is primarily a reserve power source)
Biofuel	Not scalable to any meaningful % of aviation; Plants are 500x worse than solar+electrolysis at utilization of land	High costs; competition with food; environmental damage; water use problems; NOX / particulates
Synthetic fuel	None	Fundamentally higher cost of fuel than direct H2 approaches (green H2 is the required feedstock for synfuel); Fundamentally lower efficiency than H2 electric; NOX / particulates
H2 turbine	None	Fundamentally lower efficiency than H2 electric = more fuel required; volume of fuel storage system; NOX
Hydrogen - electric	**None**	**Power density of fuel cell systems; volume and weight of fuel storage system**

Hydrogen-electric powertrains have advantage over all other alternative propulsion types, with no blockers and fixable secondary issues

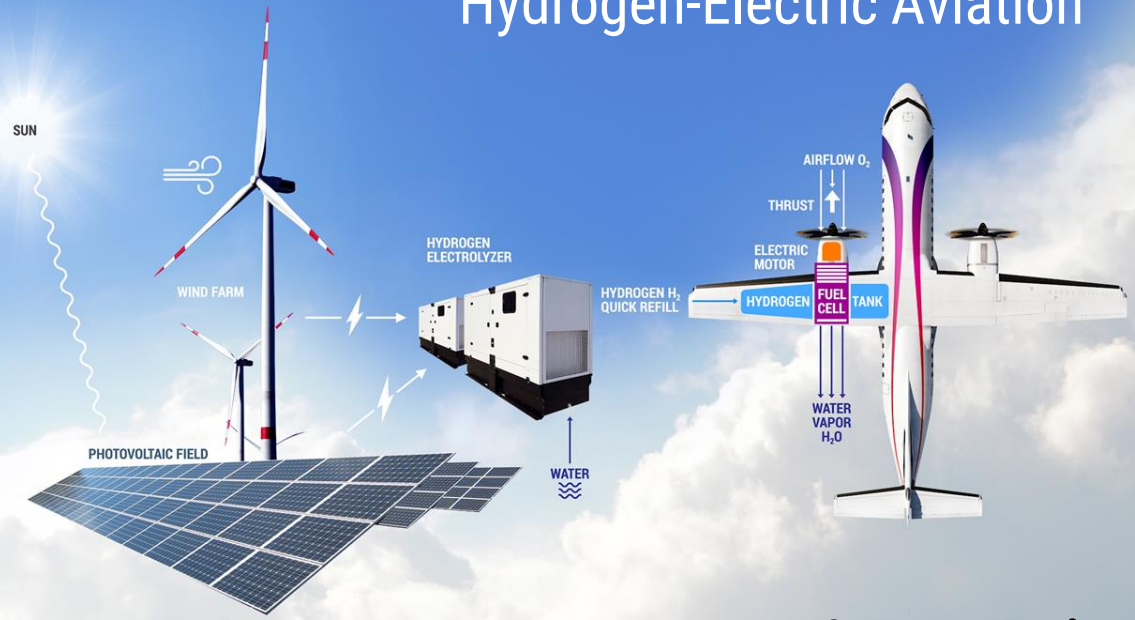
Why Hydrogen?*

4x+	Addtl 3x	50%	30%
Range even with gas H2	**Range by going to Liquid H2**	**Lower emissions**	**Lower OPEX**

True Zero Emission solution that can credibly scale to 100+ seat aircraft within 10-15 years

* compared to battery

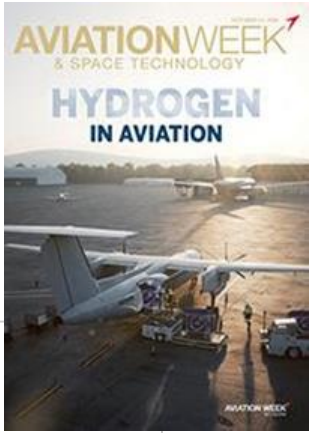
Our Vision: Renewably-Powered Hydrogen-Electric Aviation



Long range, Lower costs & Zero Emission

We Made the Right Choice; Momentum Accelerating

Hydrogen is now considered the fuel of choice for any serious decarbonization of aviation



France Plans To Make Airbus A320 Successor By 2030

by **Joanna Bailey** · June 9, 2020 · 3 minute read

The French government has today revealed plans to invest heavily in developing the plane of the future. France's ambitions for a zero carbon plane include a reworking of the popular Airbus A320 product line by 2030 and the move to hydrogen fuel by 2035. Altogether, €15bn ($17bn) will be poured into the aerospace sector over the coming years.

Step 1 (ZA-600): 19 Seats, 500 miles by 2023

Lower fuel, maintenance costs; lower noise; zero emissions end-to-end

500-mile 19-Seat is Just the Beginning...

2023 - First commercial offering

- 10-20 seats
- 500 mile range

2027

- 50-100 seats
- UAM

2030

- 100-200 seats
- 3,000 nm

2035

- >200 seats

2040

- >200 seats
- 5,000+ nm range

R&D roadmap

R&D 6-seater
Completed, >10 flights
$7M UK grant program

We are here now

Optimization & mile flight
Sep 2019 - End of 2020

R&D 19-seater flights
2H 2020 - 2021

Certification of ZA600 for commercial 9-19-seat ops
2H 2021 - 2023

Phase 1 Flight Tests 2019-2020 (USA, UK)

2017 - 2019

A number of flight tests in California, starting in Q1 2019, proving the initial powertrain design, paving the way to further, longer-distance configurations

2020 (Q1)

UK facility in Cranfield. Installation and test of the ZA250 hydrogen-electric powertrain in a 6 seat Piper Malibu.
Extensive UK flight testing & demonstrations later this year

2020 (Q2 - Q4)

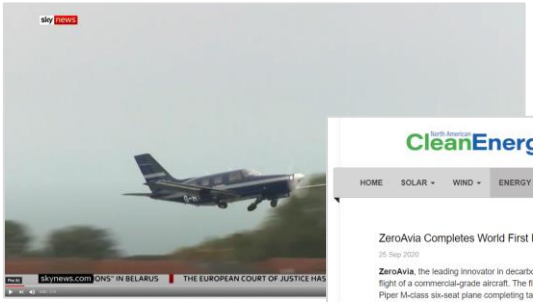
Orkney — 200+ NM — Edinburgh

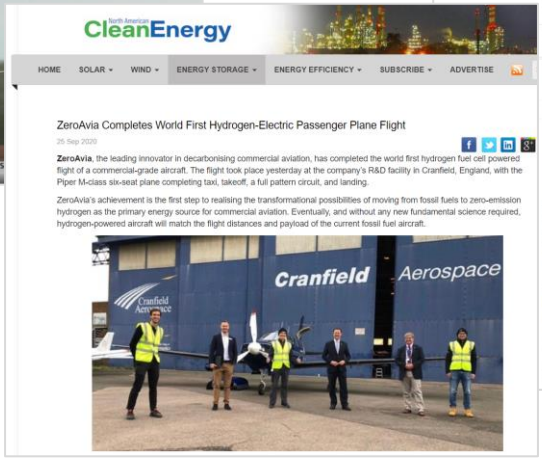
Demo up to **300 NM** range by the end of the year.
Orkney - Edinburgh

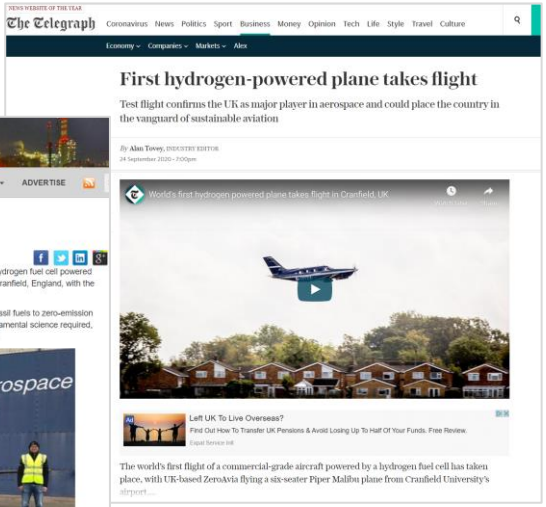
$7M UK Gov grant

HyFLYER

World's Largest Hydrogen-Electric Aircraft







Historic flight on Sep 24, 2020

Green H2 Supply - On Track to Beat Jet Fuel

Projects cite $3 / kg today, path to $1 / kg

Shell unveils world's largest offshore wind plan to power green hydrogen

Oil giant links with Gasunie for NortH2 initiative off Netherlands that aims to have 10GW of turbines in place by 2040

27 February 2020 11:18 GMT *UPDATED 28 February 2020 12:47 GMT*

Green hydrogen 'cheaper than unabated fossil-fuel H2 by 2030': Hydrogen Council

Clean hydrogen derived from renewable energy will be cost-competitive with highly polluting grey hydro

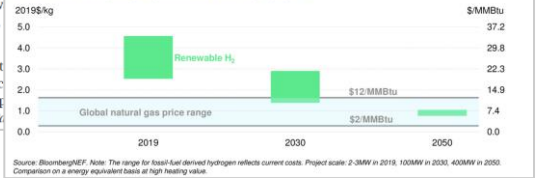
21 January 2020 14:54 GMT *UPDATED 21 January 2020*
By **Leigh Collins**

Green hydrogen produced from renew
high-emission grey hydrogen by 2030,
and consultant McKinsey.

"Within five to ten years — driven by st
80% and falling renewables' levelised c
could drop to about $1-1.50 per kg in op
average conditions," says the report, *Pa*

Renewable H_2 could even compete with the cost of natural gas

Levelized cost of hydrogen production from large projects



Source: BloombergNEF. Note: The range for fossil-fuel derived hydrogen reflects current costs. Project scale: 2-3MW in 2019, 100MW in 2030, 400MW in 2050. Comparison on a energy equivalent basis at high heating value.

Key inputs in ZA model

- $500 / kW Electrolysis CAPEX, 15-20 year depreciation
- Electrolysis OPEX at 2-3% / yr
- Fueling system is ~10% adder
- PV energy input, with optimally sized high-cycle buffer battery

$2.5 / kg in 2023 - equivalent to $1.5 / gallon jet fuel

ZeroAvia HARE (H2 Airport Refueling Ecosystem)

On / Near-site Renewables

On-site Electrolysis

On-site storage & mobile airport refueling

Hydrogen fueling support for multi-modal transport

ZeroAvia - a Market Leader in Clean Aviation

ZeroAvia in the News

Strong business development traction

Confidential discussions:

- 25+ Operators
  - 12 signed / committed to sign
  - Many are interested in replacing larger vehicles with our entry product
- 7 Aerospace majors
  - Engine OEMs
  - Airframe OEMs
- 5 New vehicle manufacturers
- Governments in 5 regions
  - Funding secured in UK

Thank You!

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